REMARKS

Claims 1-46 were pending. Claims 1-46 stand rejected. Claims 1, 2, 4, 18-20, 25, 26, 37, 38 and 41 are amended. Claims 3, 14 and 27 are canceled without prejudice of disclaimer of subject matter therein. Accordingly, claims 1, 2, 4-13, 15-26 and 28-46 will be pending upon entry of this paper.

Claim 14 is objected to by the Examiner. Claims 1, 9-28 and 31-41 were rejected under 35 USC 103(a) as being unpatentable over Harvey (US 4,592,559) in view of Mader (US 5,380,018). Claims 2-8, 29, 30 and 42-46 were rejected under 35 USC 103(a) as being unpatentable over Harvey in view of Mader and further in view of Schall (US 20050006006).

Amendments to the Claims

Claim 1 is amended to include the limitation that the "piston ring is made of a material comprising about 64 wt% to about 68 wt% cobalt." Support for this amendment may be found, for example, in the original specification at paragraph [0033]. Claims 2 and 4 are amended to correct informalties. Claim 25 is amended to include the limitation that the gap width be "about 1.4 to 2.0 times greater than said thickness [of the piston ring]." Claim 25 is also amended to include the limitation that the "piston ring comprises about 64 wt% to about 68 wt% cobalt and about 26 wt% to about 30 wt% chromium." Support for these amendments may be found, for example, in the original specification at paragraphs [0023] and [0033]. Claim 41 is amended to include the limitation that the "piston ring is formed of a material comprising about 64 wt% to about 68 wt% cobalt." Support for this amendment may be found, for example, in the original specification at paragraph [0033]. Finally, claims 18-20, 37 and 38 are amended to more specifically define the recesses on the piston ring. Support

for these amendments may be found, for example, in the originally filed drawings. No new matter is added.

Examiner Interview

An examiner interview was conducted between the Examiner and Applicants' representative. Applicant's representative and the Examiner discussed possible claim amendments to clearly distinguish the invention from the cited prior art. In particular, Applicant's representative urged the Examiner that the elements such as cobalt concentration in the piston, gap width, radius of curvature, and the like are not result effective variables that would be considered as routine experimentation to optimize. In addition, Applicant's representative noted that the results of Table 1 show the importance of certain features, as claimed, of the present invention. These amendments are substantially as presented above. While no agreement was reached, Applicant's representative greatly appreciates and thanks the Examiner for his time, candor and assistance in this case.

Claim Objections

Claim 14 is objected to as not limiting the subject matter of a previous claim. Claim 14 has been canceled and, thus, the objection obviated. Reconsideration and withdrawal of the objection to claim 14 is respectfully requested.

Claim Rejections – 35 USC 103

Harvey (US 4,592,559)

Harvey discloses a seal structure for positioning between a piston and a cylinder. The seal structure includes a band ring and a backup ring. See, for example, column 2, lines 49-51 and Figure 1 of Harvey.

Mader (US 5,380,018)

Mader discloses a piston ring that may result in a non-uniform radial pressure distribution of the ring against a cylinder. See column 2, lines 28-33 of Mader.

Schall (US 20050006006)

Schall discloses an iron-based alloy that contains the elements cobalt, carbon, silicon, manganese, chromium, molybdenum, niobium, cobalt [sic], and tungsten, and optionally also minor amounts of one or more of aluminum, nickel, vanadium, nitrogen and titanium. This alloy may be useful for a long-life turbocharger nozzle ring. See the abstract of Schall.

Claims 1, 9-28 and 31-41 stand rejected under 35 USC 103(a) as being unpatentable over Harvey in view of Mader. Claims 2-8, 29, 30 and 42-46 stand rejected under 35 USC 103(a) as being unpatentable over Harvey in view of Mader and further in view of Schall.

The Examiner states that Harvey discloses a ring having a height that is about 4.5 to 6.4 times larger than its thickness. This is the first point to which Applicant disagrees. The piston ring of Harvey has a structure that includes a band ring and a backup ring. While the band ring may fall into the above claimed range (about 4.5 to 6.4), the entire piston ring of Harvey does not fall into this range, with a thickness of about 0.2 inch and a height of about 0.5 inch.

The Examiner also states that Harvey discloses a gap extending through the piston ring, directing Applicant to Figure 2 of Harvey. Applicants respectfully disagree. While Figure 2 shows a gap (labeled as element (30)) in the band ring (14), there is now gap in backup ring (16). Furthermore, assuming element (32) in Figure 2 shows a gap in the backup ring (16), Applicants urge that this still does not teach or fairly suggest a gap in the piston ring (as a whole). As a matter of fact, independent claims 1 and 25 require the gap to extend **completely through** the ring, which clearly is not the case taught by Harvey.

Mader is relied upon by the Examiner for a teaching of a ring with a gap. While not acquiescing to the Examiner's reading of Mader, Applicants respectfully submit, for the reasons submitted below, that neither Harvey, nor Mader, nor the combined teachings of Harvey and Mader, as set forth by the Examiner, teach or fairly suggest the present invention.

In particular, regarding independent claim 1, the claim requires a gap width being "about 1.4 to about 2.0 times greater" than the thickness of the ring. In addition, claim 1 requires the piston ring be "made of a material comprising about 64 wt% to about 68 wt% cobalt." Neither Harvey nor Mader teach or fairly suggest these limitations.

Independent claim 25 requires the same gap width and cobalt range limitations and further requires the piston ring comprise "about 26 wt% to about 30 wt% chromium." In addition, claim 25 requires the height be "about 4.5 to about 6.4 larger" than a thickness of the ring. Neither Harvey nor Mader teach or fairly suggest these limitations.

Independent claim 41 requires the same gap width, height and cobalt composition limitations of claims 1 and 25. Neither Harvey nor Mader teach or fairly suggest these limitations.

Independent claim 42 requires the same cobalt composition of claims 1, 25 and 41. In addition, claim 41 requires a leading edge of the piston ring having "an arc having a radius of curvature of less than or equal to about 4 times said height." Further, claim 41 requires the piston to be made of "about 26 wt% to about 30 wt% chromium, about 3.5wt% to about 5.5 wt% tungsten, and about 0.5wt% to about 2 wt% carbon." Neither Harvey nor Mader teach or fairly suggest these limitations.

Finally, independent method claim 45 requires the same gap width limitation of claim 1, the same height limitations of claim 25, the same radius of curvature limitation of claim 42, and the same piston ring composition of claim 42. Neither Harvey nor Mader teach or fairly suggest these limitations.

The Examiner admits, at Page 3 of the office action, that Mader does not relate the size of the gap to the thickness of the ring. Also at page 3, the Examiner admits that Harvey does not appear to disclose, for example, "an arc with a radius." At page 4 of the office action, the Examiner admits that Schall does not teach the cobalt being within the claimed range. For each of these admissions, the Examiner states that "it is not considered inventive to discover the optimum or workable ranges by routine experimentation absent some showing of criticality," citing In re Aller.

Applicants note that a particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be considered as routine experimentation. In re Antonie, 559 F.2d 618, 195 USPQ 6 (CCPA 1977). In the present case, Applicants respectfully submit that the gap width, the radius of curvature of the leading edge of the ring, and

the amount of cobalt making up the ring are all variables that have not been recognized as result-effective variables.

Regarding the gap width (as presented in, for example, independent claims 1, 25, 41 and 45), while Mader does describe the gap width being wider before installation than after installation (to give the desired radial pressure distribution), Mader does not disclose any result achieved by changing the gap width of the installed ring, especially not in relation to the thickness of the ring. The same line of reasoning applies to Harvey, assuming, *arguendo*, that there is a gap in the ring of Harvey.

Regarding the radius of curvature of the leading edge of the ring, none of the cited art appears to even discuss this feature of the claims (such as independent claim 42). Clearly this variable cannot be considered a result-effective variable, and thus, the determination of the optimum or workable ranges of this variable cannot be characterized as routine experimentation.

Finally, regarding the cobalt concentration range (as presented in, for example, independent claims 1, 25, 41, 42 and 45), Schall (the only of the cited art that even describes the ring being made of cobalt) discloses that the ring may be made of 12-18 % cobalt. There appears to be no discussion in Shall of how altering the amount of cobalt may achieve any specific result. Therefore, the cobalt concentration in the ring cannot be considered a result-effective variable, and thus, the determination of the optimum or workable ranges of this variable cannot be characterized as routine experimentation.

While Applicants submit that the above discussion fully supports patentability of independent claims 1, 25, 41, 42 and 45, as well as those claims dependent therefrom, Applicants further direct the Examiner's attention to Table 1 of the specification. In comparing Example 2 to Comparative Example 3, one

can see that, with other variables being the same, the piston ring material is important for ring wear. More specifically, the cobalt range of from about 64 wt% to about 68 wt% is important to the piston ring of the present invention. Example 2 demonstrates one example close to the midpoint of this range (66.3 wt% Co).

Furthermore, still referring to Table 1 of the specification, in comparing Example 1 and Example 2, one can see how, from going from a gap width being 1.2 times the ring thickness (Example 1) to a gap width being 1.76 times the ring thickness (Example 2), the ring wear improves. This data helps show how the gap width being from about 1.4 to about 2.0 may be important in certain embodiment of the present invention.

For the plurality of reasons described above, Applicants respectfully submit that the pending claims are neither taught nor fairly suggested by the cited art of record. Reconsideration and withdrawal of the rejection of claims 1, 9-28 and 31-41 as being rejected under 35 USC 103(a) for being unpatentable over Harvey in view of Mader as well as the rejection of claims 2-8, 29, 30 and 42-46 as being rejected under 35 USC 103(a) for being unpatentable over Harvey in view of Mader and further in view of Schall is respectfully requested.

CONCLUSION

Applicants would like to again thank the Examiner for the telephone interview to discuss the instant application. Reconsideration and withdrawal of the Office Action with respect to Claims 1, 2, 4-13, 15-26 and 28-46 is requested. Applicants submit that the claims are now in condition for allowance. Early notice to that end is earnestly solicited.

In the event the examiner wishes to discuss any aspect of this response, please contact the attorney at the telephone number identified below.

The Commissioner is hereby authorized to charge payment of any fees due with this communication or credit any overpayment to Deposit Account No. 50-0851.

Respectfully submitted,

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